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Title:	GCD: Current Performance / Issues
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Intended for:	LANL purchased a man instrument (pulse dilation PMT) from the Sydor Instruments, Inc. The company requests to get experimental data obtained using the instrument, for their record.
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GCD: Current Performance / Issues

Gas Cherenkov Detector (GCD) at NIF



Hermann Geppert-Kleinrath and
Yongho Kim

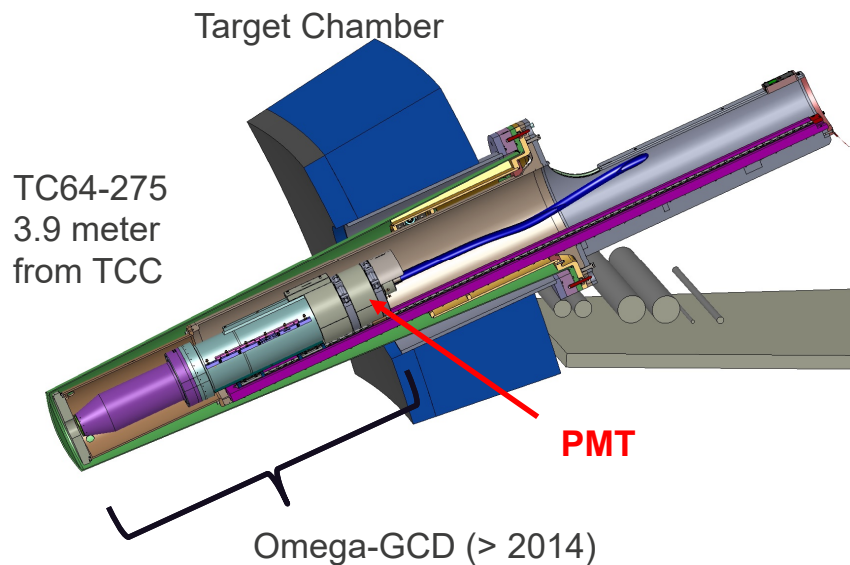
Dec. 11, 2019



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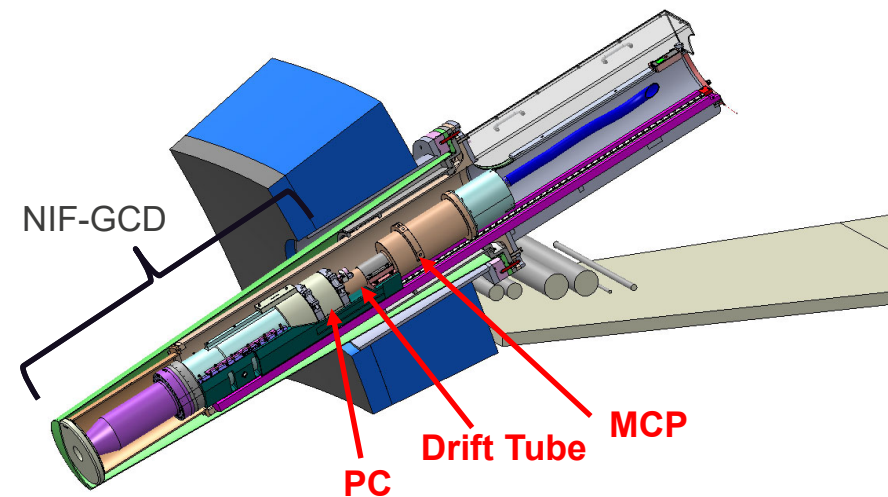
NIF GCD aims to improve time resolution (10 ps) using a Pulse Dilation Photomultiplier (PD-PMT)

Phase I: Omega-GCD with **PMT**



- N161205 (OQ)
- 100 ps
- $> 1\text{E}+14$

Phase II: NIF-GCD with **PD-PMT**



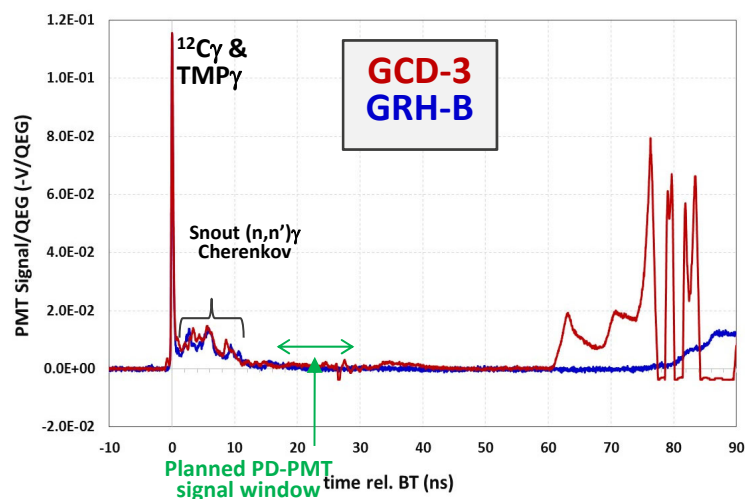
- N180930 (PDPMT OQ)
- N191105 (NIF-GCD OQ)
- 10 ps
- $> 1\text{E}+15$

GCD
+
PMT

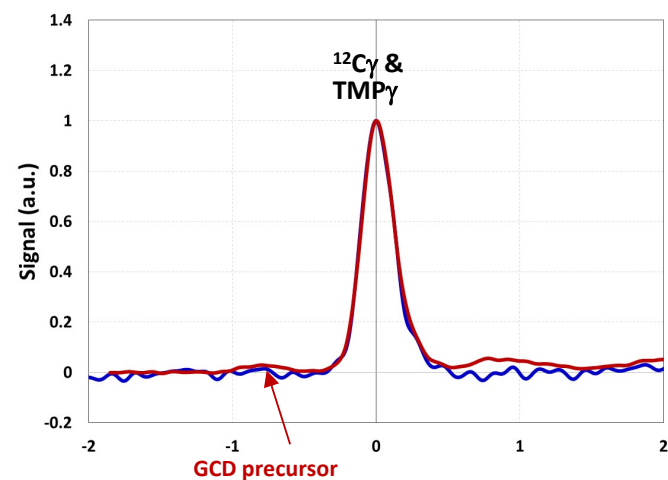
$^{12}\text{C}\gamma$

N161205 @ 2.9 MeV

Stitched & Scaled Data 100 ns window

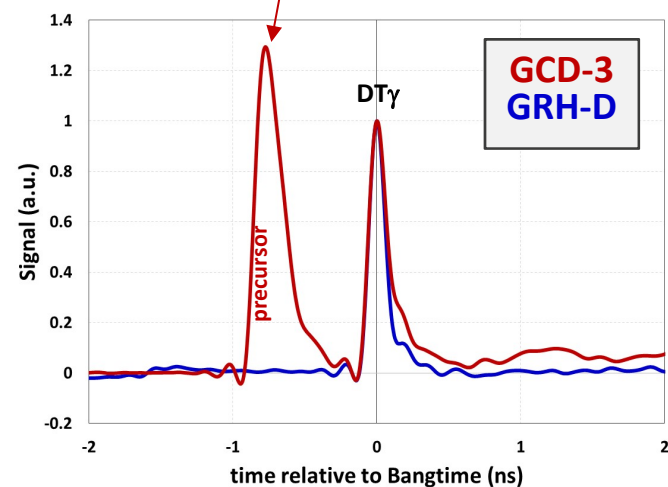
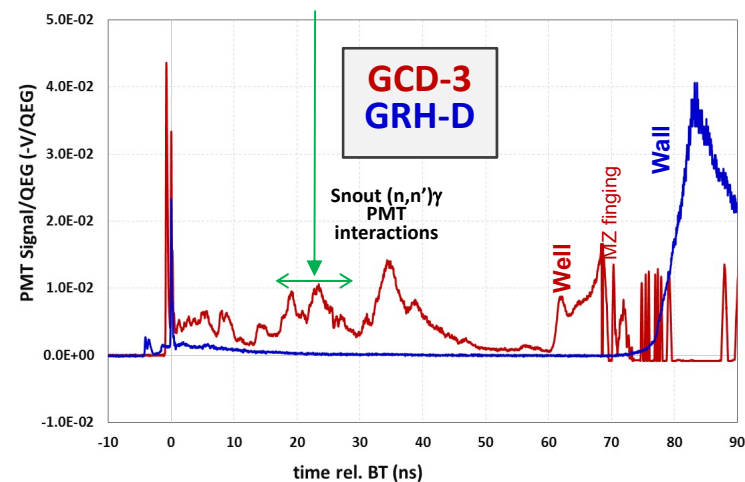


Deconvolved Data 4 ns window

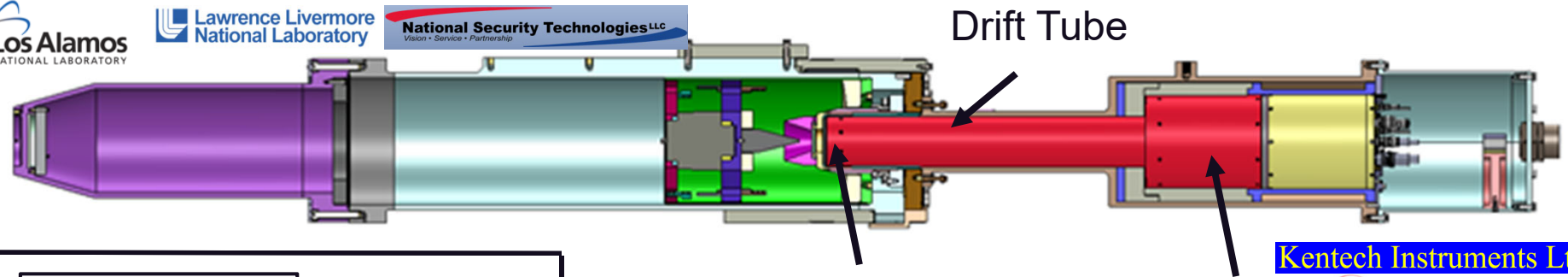


$\text{DT}\gamma$

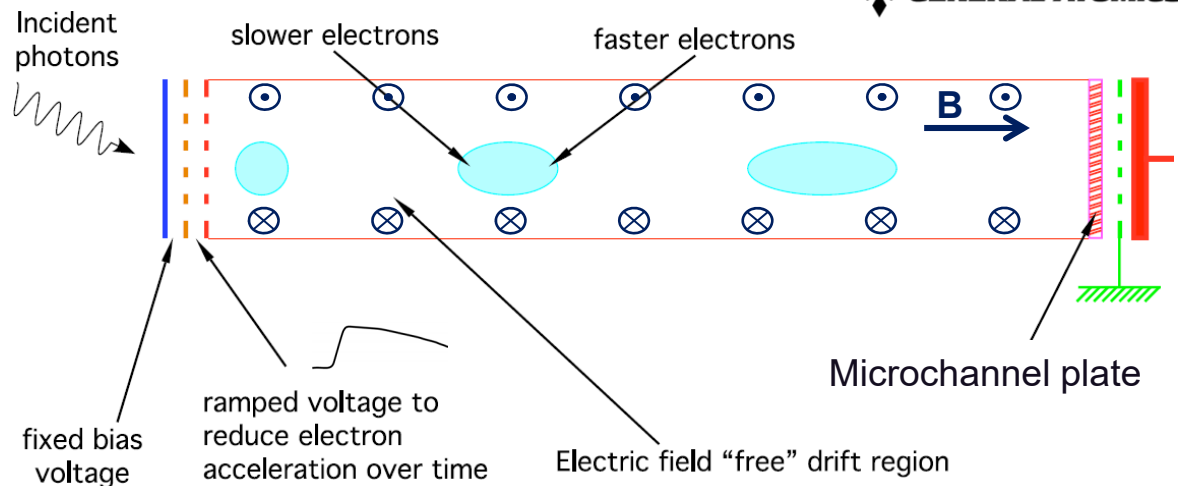
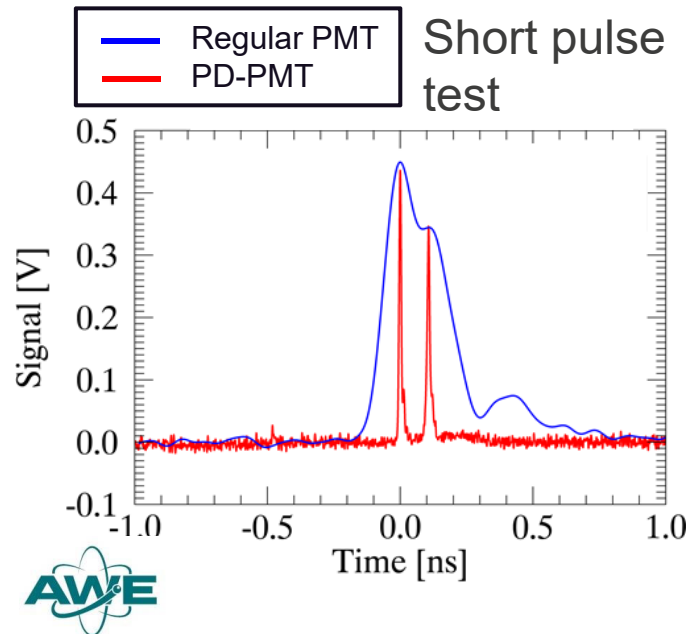
N170226 @ 8 MeV



PD-PMT for GCD responses to Optical Light

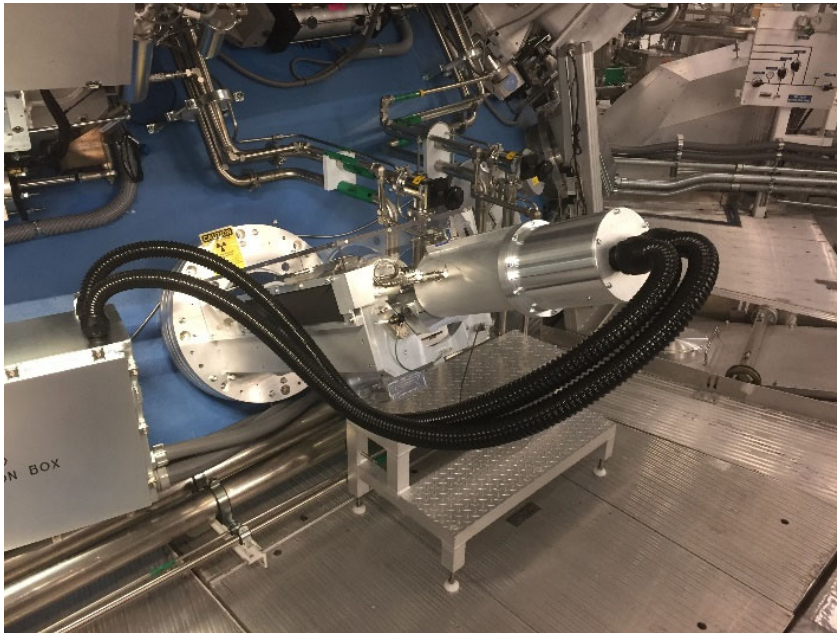


Kentech Instruments Ltd.

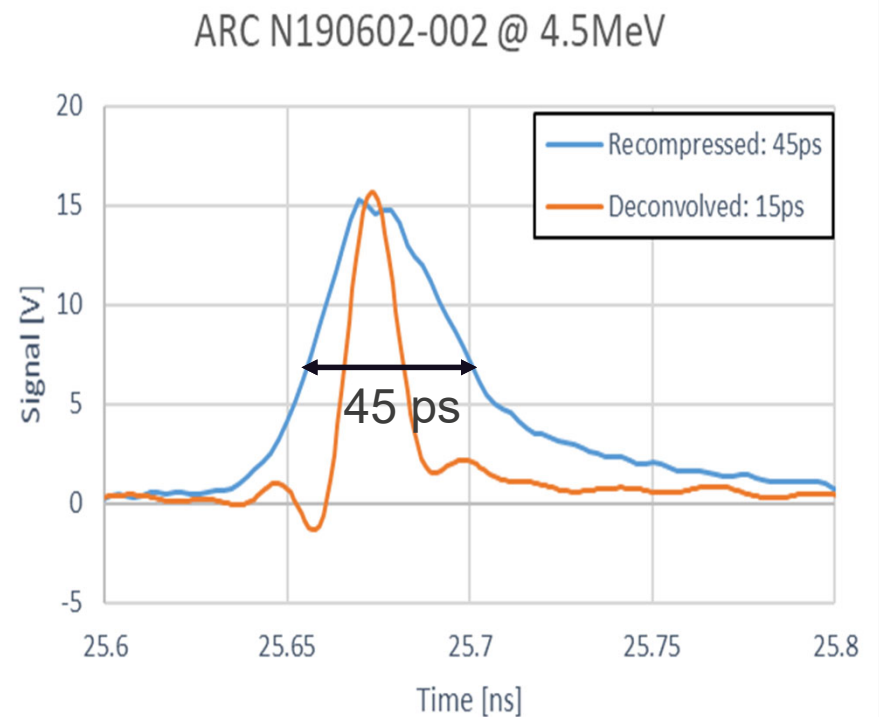


GCD/PD-PMT resolved < 100 ps gamma-signal during ARC shot

PD-PMT installed on the back end of the Gas Cherenkov Detector on the NIF (Aug 2018)



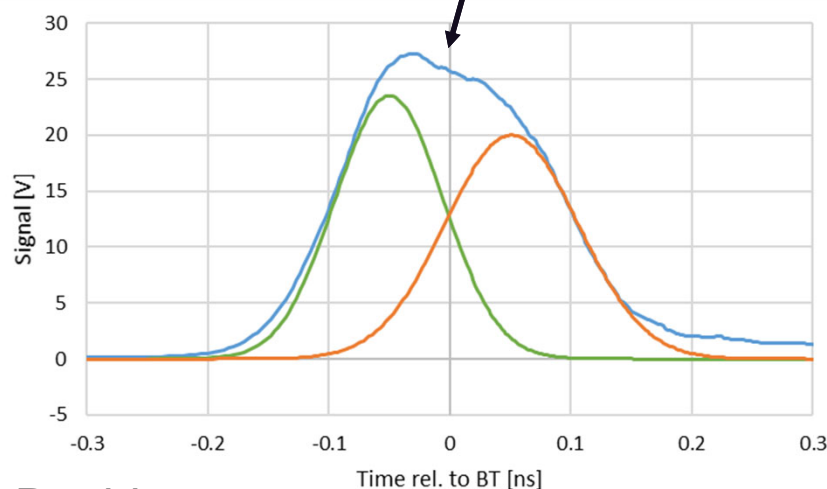
< 100 ps during ARC shot



GCD/PD-PMT reveals structure in reaction history not seen in sister instrument GRH

@ 2.9 MeV mode

Feature visible in PD-PMT data but not in GRH

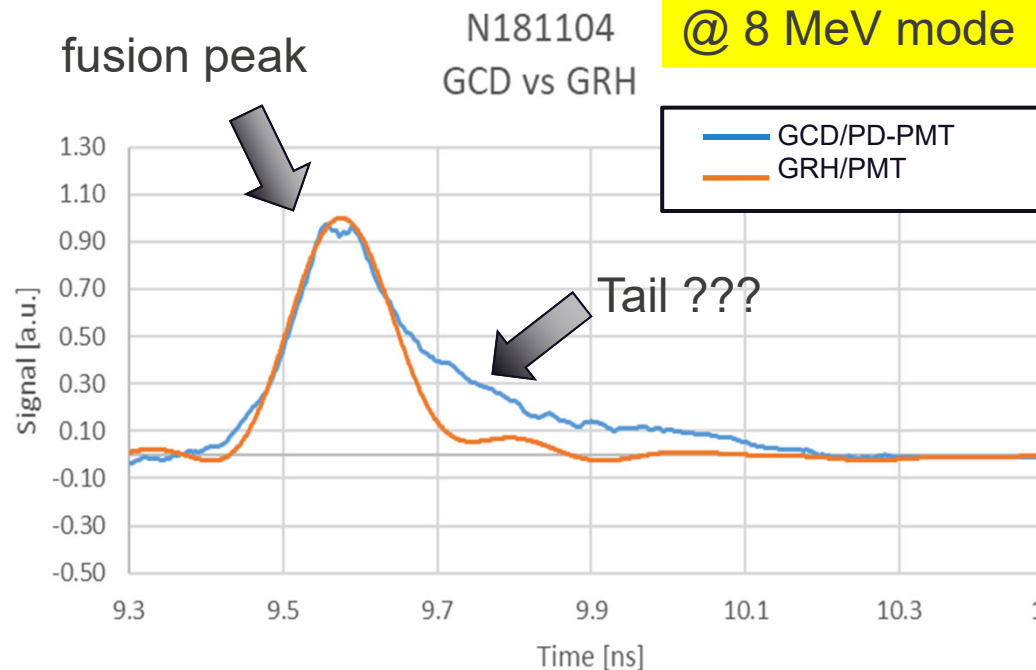


Double
Gaussian
Decomposition

$^{12}\text{C}\gamma$ Signal

Hohlraum
/TMP- γ
Signal

@ 8 MeV mode



The newly installed GCD/PD-PMT confirms the burn width (FWHM) of existing GRH/PMT agree with GCD/PD-PMT

Issues: is the Tail real (part of fusion signal) or not. If not, where it comes from?

	Hypothesis	Response	Evidences
1	Tail is real (part of fusion signal)	No	<ul style="list-style-type: none"> - Tail does not scale with Cherenkov threshold - GCD data does not agree with GRH
2	Precursor is causing the tail	No	<ul style="list-style-type: none"> - Background shot (w/o gas)
3	PD-PMT is causing the tail	No	<ul style="list-style-type: none"> - 5 GHz optical light calibration
4	8 MeV threshold is not high enough or n- γ causes the tail	No	<ul style="list-style-type: none"> - 10 MeV test
5	Impurity in CO ₂ gas is causing the tail	No	<ul style="list-style-type: none"> - Adding N₂ gas
6	CO ₂ excitation/de-excitation is causing the tail	Probably Yes (lower energy n- γ can still excite gas)	On-going work <ul style="list-style-type: none"> - W-filter test - Optical blue light filter - Better shielding test